City of Tigard

- **Data Assessment**
- **Water Utility Pilot Project Recommendations**
- **Water Utility Geodatabase Design**

Final

September 2007

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City of Tigard

DATA ASSESSMENT

WATER UTILITY PILOT PROJECT RECOMMENDATIONS

WATER UTILITY GEODATABASE DESIGN

FINAL

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Tigard GIS Data Assessment

The Data Assessment is comprised of a matrix that includes a recommended thematic organization structure, development of feature datasets, and an evaluation of individual layers or feature classes. Detailed recommendations for the proposed feature datasets of addresses, water, sewer/storm, and transportation are found in appendices.

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Table 1

Proposed Geodatabase Organizational Format & Data Development/Maintenance Procedures

Tetra Tech; July, 2007

TIGARD SDE INSTANCE

Key to Cell Colors

Red	Highest Priority for Data Development/Maintenance
Orange	High Priority for Data Development/Maintenance
Yellow	Future Priority for Data Development/Maintenace when Resources are Available

Key to Departments

CD	Community Development
PW	Public Works
ENG	Engineering
PD	Police
LIB	Libraries
AD	Administration
FIN	Finance

Key to Organization Codes

TIG	City of Tigard
WC	Washington County
PM	Portland Metro
CWS	Clean Water Services
PPB	Portland Police Bureau
GEO	Oregon Geospatial Enterprise Office
PSU	Portland State University
OTH	Other Outside Organization

Key to Status

COM	The layer is generally complete and ready for use.
INC	The layer has been created but falls short of meeting current needs. Requires a focused project effort to update/repair data prior to reliable use.
NON	The layer currently does not exist.
REV	Revisit and Update Existing Model

Layer Folder	Storage Method	Feature Class	Source	Status	Recommended Action	Potential Data Sources	Notes
Address	SDE Layer	**Address Points (point)**	TIG/WC/PM	INC	See Supplement "A"	Existing City point address database Washington County Assessor's database USPS postal database Business license database	This is a data project per the "Recommendations and Strategies" document.
Administrative Boundary	Feature Dataset (TIG_Admin_bndry)	**Annexations**	TIG	COM	Continue update using "effective year." Remove unused fields in attribute table	CD	The City has already created topologies to synchronize annexations with the City Boundary and other related administrative boundaries
		Tigard City Boundary	TIG	COM	Update upon incorporation of areas	CD	
		Police Districts	TIG	COM	Update when changed	PD	Five police districts
		Police Grids	TIG	COM	Update when changed	PD	Subdivisions of districts for patrol (44 total)
		Neighborhood Boundaries	TIG	COM	Add names if applicable (12 areas)	CD	
		Service Boundary, IGA Area	TIG	COM	Update upon approval of continuing agreement (if necessary)	CD and WC	Urban Services Boundary intergovernmental agreement w/Washington County
		Tigard Water Services Area	TIG	COM	Update when changed	PW	
		Public Works Areas	TIG	COM	Update when changed	PW	
		Tigard Urban Planning Areas	TIG	COM	Update when changed	CD	
Business Geographics	SDE Layer	County Businesses (or major firms - 100 plus employees)	OTH/WC	NON	Update annually or as needed	Commercial building permits (CD) Portland Metro Buildable Lands Study Tigard Commercial Lands Study (2001) Business license database (FIN, Springbrook) Tigard Chamber of Commerce	**Data Project**
RECOMMENDATION: Although left as separate layer folders, business geographics and community/public services could be combined into a single "Points of Interest" layer, with attribution distinguishing the point type (public institutions, health care, retail, etc.)	SDE Layer	**City Businesses**	TIG	NON	Update annually or as needed	Commercial building permits (CD) Business license database (FIN, Springbrook) Tigard Commercial Lands Study (2001) Tigard Chamber of Commerce	**Data Project -** Springbrook Cleanup
Community/Public Services	SDE Layer	**Major Points of Interest, Point (Malls, Shopping Centers, Business Parks, Civic Centers, Recreational Facilities)**	TIG/WC/OTH	INC	Update annually or as needed	Commercial building permits (CD) Business license database (FIN, Springbrook) Tigard Commercial Lands Study (2001) Tigard Chamber of Commerce RLIS Tax Lots	**Data Project**

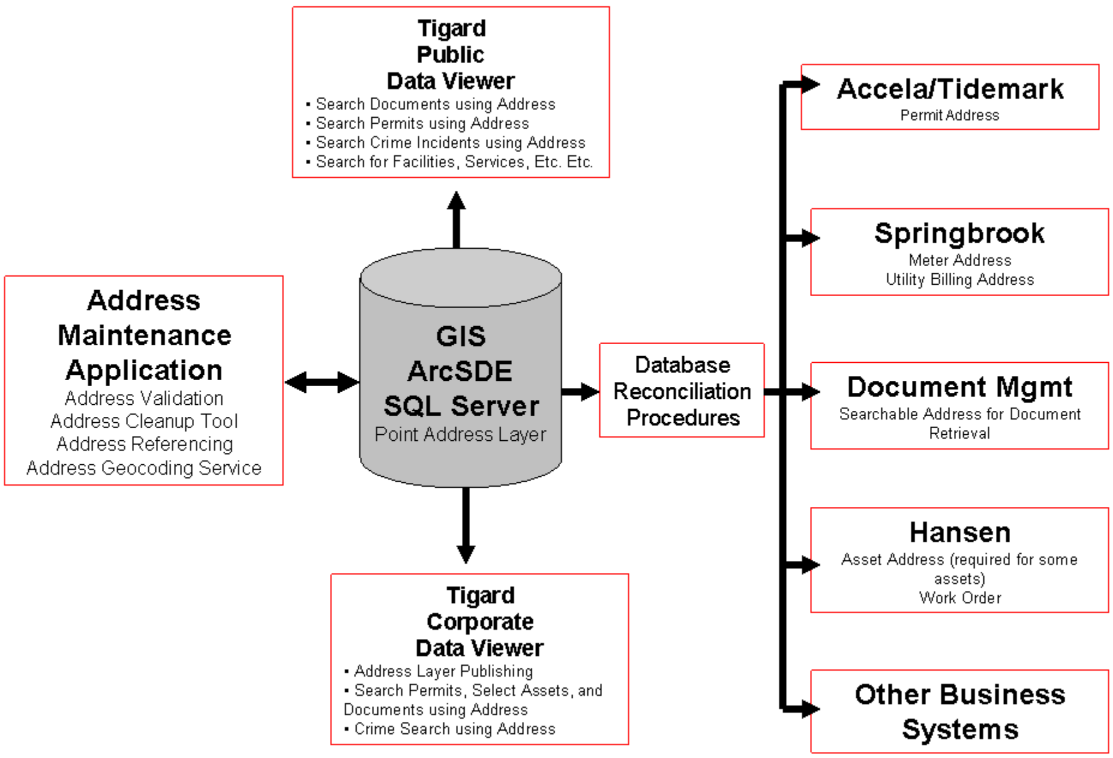
Layer Folder	Storage Method	Feature Class	Source	Status	Recommended Action	Potential Data Sources	Notes
	SDE Layer	Major Points of Interest, Poly (Malls, Shopping Centers, Business Park, Civic Centers, Recreational Facilities)	TIG/WC/OTH	NON	Update annually or as needed	Digitize using aerial photos	**Data Project**
	SDE Layer	**Facilities of Interest, Point (schools [include admin, maintenance, bus barn], hospitals, urgent care, nursing/assisted living, maintenance facilities, fueling stations, hotels, motels, gov't facilities [e.g., Fed/State/Cnty], churches, day care, apartment complexes, Shelters**	TIG/WC/OTH	INC	Update annually or as needed	Commercial building permits (CD) Business license database (FIN, Springbrook) Tigard Commercial Lands Study (2001) Tigard Chamber of Commerce RLIS Tax Lots	**Data Project**
	SDE Layer	**Facilities of Interest, Poly (schools, hospitals, urgent care, nursing/assisted living, maintenance facilities, fueling stations, hotels, motels, gov't facilities [e.g., Fed/State/Cnty], churches, day care, apartment complexes, Shelters, museums**	TIG/WC/OTH	NON	Update annually or as needed	Digitize using aerial photos	**Data Project**
Cultural	SDE Layer	Historic Buildings, sites	TIG/OTH	NON	Create the layer using interns or local student assistance. Work with Tigard Area Historical and Preservation Assoc.	http://www.oregon.gov/OPRD/HCD/NATREG/docs/oregon_nr_list.pdf http://www.oregon.gov/OPRD/HCD/SHPO/index.shtml http://www.ci.tigard.or.us/community/about_tigard/historic.asp	**Data Project**
Demographics	SDE Layer	2000 Census (Tigard Area)	OTH	COM	Refresh after the 2010 census and add block level data	US Bureau of Census http://arcdata.esri.com/data/tiger2000/tiger_statelayer.cfm?sfips=41	
Electrical		**Placeholder**					
Emergency Operations/Preparedness		See Facilities of Interest, other assets, structures					
Environmental Regulation	SDE Layer	**Significant Habitat (Goal 5)**	TIG/CWS	COM	Coordinate with CWS and update as necessary	CWS	
	SDE Layer	**CWS Vegetated Corridor**	TIG/CWS	COM	Coordinate with CWS and update as necessary	CWS	
	SDE Layer	**Goal 5 Safe Harbor**	TIG/CWS	COM	Coordinate with CWS and update as necessary	CWS	
	SDE Layer	**CWS Potential Impact**	TIG/CWS	COM	Coordinate with CWS and update as necessary	CWS	
	SDE Layer	Mitigation Sites	TIG/CWS	NON	Coordinate with CWS and update as necessary	CWS	**Data Project**
	SDE Layer	Restoration Areas	TIGCWS	NON	Coordinate with CWS and update as necessary	CWS	**Data Project**
Hydrography	Feature Dataset	**Wetlands**	TIG/CWS	COM	Update with redelineations related to development	CWS	
	TIG_Hydro	**Watersheds (CWS)**	CWS	COM	Coordinate with CWS and update as necessary	CWS	
		Streams/Rivers	PM	COM	Update from PM on City's regular basis	PM	
		Open Water	PM	COM	Update from PM on City's regular basis	PM	
Hypsography	SDE Layer	1 Ft Contours (from LIDAR)	PM	COM	Update from PM on City's regular basis	PM	
	SDE Layer	DEM (from LIDAR)	PM	COM	Update from PM on City's regular basis	PM	
	SDE Layer	Hillshade (from LIDAR)	PM	COM	Update from PM on City's regular basis	PM	

Layer Folder	Storage Method	Feature Class	Source	Status	Recommended Action	Potential Data Sources	Notes
Land Use	Feature Dataset	Zoning	TIG	COM	Update once Council Approves Rezone or Amendment	CD	
		Comp Plan	TIG	COM	Update during comp plan amendment process	CD	
	TIG_Landuse	Parking Overlay (A/B)	TIG	COM	CD to update as needed	CD	
		Forest Deferral	TIG	COM	CD to update as needed	CD	
		Approved Subdivisions/Minor Partitions	TIG	COM	CD to update annually or as needed	CD	
		Applied Subdivisions/Minor Partitions	TIG	INC	Develop a method for CD to create polygons upon acceptance of a land use application	CD/Tidemark	**RECOMMENDATION:** Formalize the maintenance of this layer to track plat activity during the permitting phase. Could be used later in a publicly available permit status web site.
Natural Hazards	SDE Layer	CWS Floodplain	CWS	COM			
	SDE Layer	Zero Rise Floodway	TIG	COM			
	SDE Layer	Floodplain removals	TIG	COM			
	SDE Layer	Wildfire Hazards	TIG	NON			**Data Project**
	SDE Layer	Landslide Hazard	TIG	NON			**Data Project**
Parks		Tigard Parks/Greenways/cemetery			Update annually or where new park	PW/Parks Division	
Planning		2*** Employment Forecast	TIG/PSU	COM	Update annually or as needed	CD	
		2*** Household Forecast	TIG/PSU	COM	Update annually or as needed	CD	
		Permits, Active	TIG	NON	CD should create a point for the building permit upon application. Should be triggered at the time of creating the new address point.	CD/Tidemark	**Data Project**
		New Construction	TIG	COM		CD	
		2002-2007 Buildable Lands	TIG	COM		CD	
		Vacant Lands	TIG/WC	NON	Build layer from WC parcels. Retire vacant parcels upon issue of building permit.	CD	
		Measure 37 Claims	TIG	COM		CD	
Property		Public property (City, County, ODOT)	TIG/WC/OTH	COM		WC	
		Housing Authority Property		COM		WC	
		Easements	TIG/WC	NON		WC	
Reported Crimes		All Crimes	TIG/PPB	COM	PD	TIG/PPB	
		Part 1 Crimes	TIG/PPB	COM	PD	TIG/PPB	
		Part 2 Crimes	TIG/PPB	COM	PD	TIG/PPB	
Sanitary **RECOMMENDATION:** Improve Hansen/GIS integration. See Supplement C for details.	Feature Dataset	Manholes	TIG	INC	See Supplement C. The sanitary system must be updated on a regular (weekly) basis as the system is expanded or updated.	TIG	**Data Project**
	TIG_Sanitary	Lines	TIG	INC			
		Sanitary Reimbursement Areas	TIG	INC			
		Sanitary Drainage Basin	TIG	INC			
		As-Builts	TIG	INC			
Stormwater **RECOMMENDATION:** Improve Hansen/GIS integration. See Supplement C for details.	Feature Dataset	Catch Basins	TIG	INC	See Supplement C. The storm system must be updated on a regular (weekly) basis as the system is expanded or updated.	TIG	**Data Project**
	TIG_Storm	Manholes	TIG	INC			
		Lines	TIG	INC			
		Pond/Detention Facilities	TIG	INC			
		As-Builts	TIG	INC			
Structures/Improvements		Building footprints (from LIDAR)	TIG/PM	NON	Update annually or as needed	Portland Region Intergovernmental LIDAR Project	**Data Project**
		City Building/Structures	TIG	NON			**Data Project**
		CIP	TIG	NON	Update as CIP is updated		**Data Project**

Layer Folder	Storage Method	Feature Class	Source	Status	Recommended Action	Potential Data Sources	Notes
		Other City Assets	TIG	NON			Data Project
		Park infrastructure/assets (multiple layers -e.g., shelters, maintenance buildings, restrooms, parking lots, benches)	TIG	NON			Data Project
		As-Builts	TIG	INC	Scan as acquired		Data Project
Transportation	Feature Dataset	Accidents	TIG/PD	NON	See Supplement D. The transportation system must be updated on a regular (weekly) basis as the system is expanded or updated.	TIG	Data Project
RECOMMENDATION: Create Single Feature Dataset for all Transportation Features and Events **RECOMMENDATION:** Improve Hansen/GIS integration. See Supplement D for details.	TIG_Trans	Street Centerline	TIG/PM	INC			
		Street Casings	TI	INC			
		Bike Facilities	TIG/PW	REV			
		Trails	TIG/PW	REV			
		Trail Mile Points	TIG/PW	NON			
		Traffic Count Locations	TIG/PW	REV			
		TSP (project locations)	TIG/PW	NON			
Street Features	TIG_Trans	Bridges	TIG/PW	EXT			
		Overpasses	TIG/PW	EXT			
		Bulb outs	TIG/PW	NON			
		Speed Humps/Cushions	TIG/PW	NON			
		Traffic Signals	TIG/PW	REV			
		Street Signs	TIG/PW	INC			
		Street Lights	TIG/PW	INC			
		Sidewalks	TIG/PW	NON			Data Project
		Handicap Ramps	TIG/PW	NON			
Urban Forestry		Heritage Trees	TIG/PW	NON			
		Trees Targeted for Preservation	TIG/PW	NON			
		Street Trees	TIG/PW	NON			
		Tree Mitigation Plan Information	TIG/PW	NON			
Utilities Other		Major gas/Petroleum lines	TIG/PW	COM			
		Cell Towers	TIG/PW	COM			
		Phone Service Areas	TIG/PW	COM			
		Comcast Service Area	TIG/PW	COM			
		Overhead Utilities	TIG/PW	COM			
		Power Stations	TIG/PW	NON			
Water **RECOMMENDATION:** Improve Hansen/GIS integration. See Supplement B for details.	Feature Dataset	Hydrants	TIG	INC	See Supplement B. The water system must be updated on a regular (weekly) basis as the system is expanded or updated.	TIG	Data Project
	TIG_Water	Lines	TIG	INC			
		CWS Lines	TIG	INC			
		Valves	TIG	INC			
		Maters	TIG	INC			
		Laterals	TIG	INC			
		Reservoirs	TIG	INC			
		Pump Stations	TIG	INC			
		Water Meter Zones (Meter Routes)	TIG	INC			
		Water Pressure Zones	TIG	INC			
		Park Valve Boxes	TIG	INC			
Other		Mow Areas	TIG	NON	PW to update as needed	TIG/PW	Data Project

Supplement A
Address Point Layer Creation

Underlying the point address GIS layer is a master address database that reconciles addresses before delivery to other business systems. Our recommendation is to leverage GIS as a master address database to feed these other systems (see diagram below).



The City currently has a GIS point address layer that meets several needs. It originates as a CAD layer that is later converted to GIS. Recommendations to improve this layer include the following data projects: 1.) standardize and reconcile existing addresses in Tidemark using the Oregon Geospatial Addressing Standard, 2.) identify and add missing addresses, notably business suites, apartments, and other multi-unit buildings, 3.) create a geocoding service to locate addresses to a fairly precise XY location, and 4.) adopt a system of using GIS as the primary address development and maintenance tool. It is recommended to create an address maintenance application that works within the GIS environment to accomplish this.

The address maintenance application would be created to help reconcile existing addresses as well as create and enter new addresses. It would be used by Community Development when a new address is initiated. In this environment, only a validated address could be entered into the GIS repository.

Oregon Geospatial Addressing Standard

http://www.oregon.gov/DAS/EISPD/GEO/fit/transportation/docs/OR_AddrStdv01.pdf

Example: 1235 W 19TH ST APT 24
At a minimum, the components shall be formatted as shown below:

Field Name	Length	Type	Description
UNIQ	20	Alpha or Numeric	A unique identifier within the associated address table that can be linked to other tables.
NUMBER	6	Alpha	Address Number
SUB_NUM	3	Alpha	Address Sub-number
PRE_DIR	2	Alpha	Directional Prefix
STR_NAM	30	Alpha	Street Name
STR_TYPE	4	Alpha	Street Type
SUF_DIR	2	Alpha	Directional Suffix
UNIT_TYPE	4	Alpha	Unit (i.e., APT, STE, BLDG)
UNIT_NUM	4	Alpha	Unit Number
CITY	17	Alpha	Postal City name
JURIS	17	Alpha	Jurisdictional (City) name
ST	2	Alpha	State
ZIP5	5	Alpha	Zip Code
ZIP4	4	Alpha	+4 Zip Code

Supplementary Data Fields

In the City's current point address layer, a tax account code, parcel ID, and northings/eastings are included. These are very useful fields and should be used in the addressing system.

Project Work Plan

The proposed work plan is broken into three phases:
Phase 1 (short term: 3-6 months)

1. Build address Geodata model (Arc 9.2 and SDE)
2. Finalize and adopt address standard
3. Build a comprehensive list of street names
4. Identify gaps in current address point layer

Phase 2 (mid-term: 6-12 months)

1. Engage support from department heads and key staff
2. Execute update to the GIS address point layer using parcel site addresses, building permit data, and USPS postal lists
3. Design address maintenance application

Phase 3 (long term: >12 months)

1. Build address maintenance application

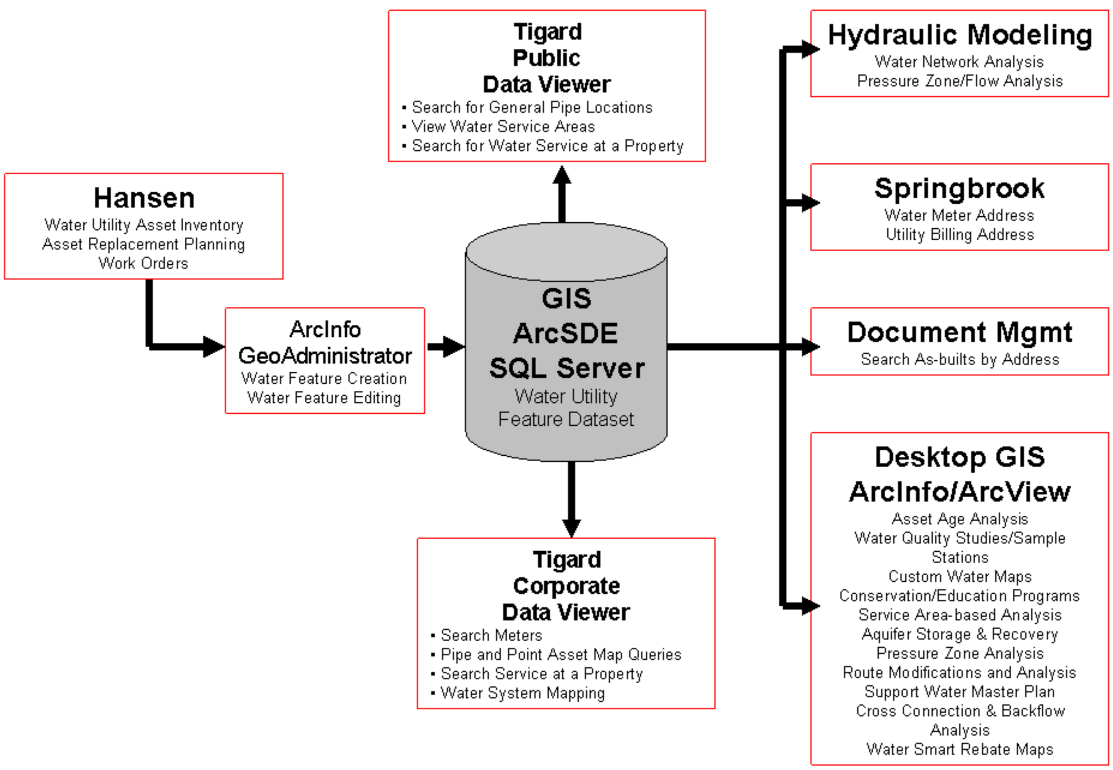
2. Build database validation procedures to push address out to external business systems
3. Validate and correct addresses in external business systems
4. Enforce address entry and validation procedures

Summary of Goals

- Develop a single enterprise address database of valid reference points and discrete site addresses using a standardized addressing model
- Develop a tool for the maintenance of reference point addresses
- Develop procedures for cleaning and validating addresses in external business systems
- Develop procedures for pushing GIS addresses out to external business systems
- Eventually use the validated address database to provide for an easy search engine for city staff and the public via map servers

Supplement B
Water Utility Layer Creation

The City's water department has been managing the GIS water utility layer using a combination of CAD and GIS. Our recommendation is to centralize the water utility data management in the GIS. The water network will be converted from non-GIS sources and organized into a Geodata model consisting of a feature dataset, feature classes, and built-in business logic. The Geodata model will accommodate synchronization with Hansen and will work cooperatively with the GeoAdministrator module. GeoAdministrator will be the primary tool for initiating new and editing existing GIS water features. Once converted and managed in the Enterprise GIS, the water system network will be deployed to several external business systems as well as standard desktop GIS applications for custom analysis and mapping (see illustration below).



Geodatabase Design

A detailed Geodatabase design for water is included in this Needs Assessment. A workshop with City Staff identified the design requirements, including topological relationships of system features, coded domains, and subtypes.

The design process included the following steps. **A similar process can be used for storm, sewer, and streets.**

1.) Identify Workflow Requirements
Workflow requirements were identified and documented in this Needs Assessment (see User Requirements document). This analysis included several detailed requirements related to the workflow. For water, the most important needs included the ability to age system components for maintenance/replacement scheduling, track the location and age of meters, and be able to create and track work orders.

2.) Develop a Conceptual Model and a Logical Model
This was a collaborative process of identifying Network Relationships, Attribute Fields, Subtypes, and Domains (the Logical Model) by sketching a conceptual model on flip charts. This was done in a workshop format with key participants from the City's Water and Public Works Department.

The Logical GDB model must identify the individual system features, network geometries, attribute fields, and topologies that are the foundation for meeting the workflow requirements. For water, this included creating a conceptual model by diagramming how mains and service lines are connected via valves and fittings. Detailed sketches of how water enters the system via service meters, reservoirs, and wells were created. Water sinks, notably hydrants, service connections and meters, as well as water quality sampling stations were drawn. The system components were then organized into a logical Geodatabase model using feature classes. For each feature class, required attribute fields, preferred subtypes, and domain lists were created. In addition to the attributes related to physical properties (type, size, and materials), it was noted that year built and manufacturer information would help scheduling maintenance and replacement projects.

3.) Identify Supporting Hansen Tables/Fields
Leveraging Hansen to manage the water system data and create work orders was a focus of the water GDB design. Opportunities to move Hansen data to the GIS layers were identified. Next, the instructions for creating a link between Hansen and GIS were reviewed. This included the addition of GIS fields (primarily "CompKey" and "CompType") required for use of GeoAdministrator.

First, the water network structure was formulated to establish a one-to-one relationship between feature records in GIS and component records in Hansen. Second, a cross-walk table was created to show which Hansen fields will specifically link to and populate the GIS attribute fields. This table will be the foundation for creating data reconciliation processes.

4.) Create the GDB Physical Model
The GDB physical schema was created in a File Geodatabase within a Feature Dataset. ArcCatalog commands were used for creating feature classes, attribute fields, subtypes, and domains. Topologies were defined using the "Create Topology" tool. The resulting GDB was exported to Visio to create the diagram poster. The large format diagram is the best media for viewing the entire feature dataset schema

and feature class details, and should be used for peer review and quality assurance checking.

Water Utility Data Fields

It is important to note that not all attribute fields identified in the GIS are directly populated by an equivalent Hansen field. The business requirements for the GIS layer demand the addition of non-Hansen fields. They will be populated and managed by the Water Utility Data Steward. It is important that a table is created depicting which GIS fields are populated by Hansen and which are not. A table similar to this is delivered with the Water Utility Geodata Model.

Hansen requires the use of an address to locate certain water feature types, notably meters and sample stations. Because the GIS inherently stores location, the use of an address is less important. Nonetheless, address still plays a functional role in identifying private services (primarily for meters). It is important that all addresses stored in Hansen and subsequently in the water feature classes are derived from the address point layer in order to maintain consistency (see Supplement A).

Project Work Plan

The proposed work plan is broken into three phases:
Phase 1 (short term: 3-6 months)

1. Build water utility Geodata model (Arc 9.2 and SDE) (see process outlined above)
2. Develop Pilot Project Guidelines
    a. Identify Source Data (1995 GPS survey, as-built CAD data, hard-copy as-built records)
    b. Develop Spatial Catalog of Non-GIS Data (quarter section identification of CAD and hard-copy drawings)
    c. Outline Pilot Study Area (should represent a variety of source data types)

Phase 2 (mid-term: 6-12 months)

1. Engage support from department heads and key staff
2. Execute Pilot Project
3. Test GeoAdministrator using Pilot Area (troubleshoot connectivity and implement modifications to physical GDB design accordingly)

Phase 3 (long term: >12 months)

1. Complete and document GeoAdministrator application
2. Complete water utility conversion process and associated metadata
3. Formalize data stewardship role for Water Utilities

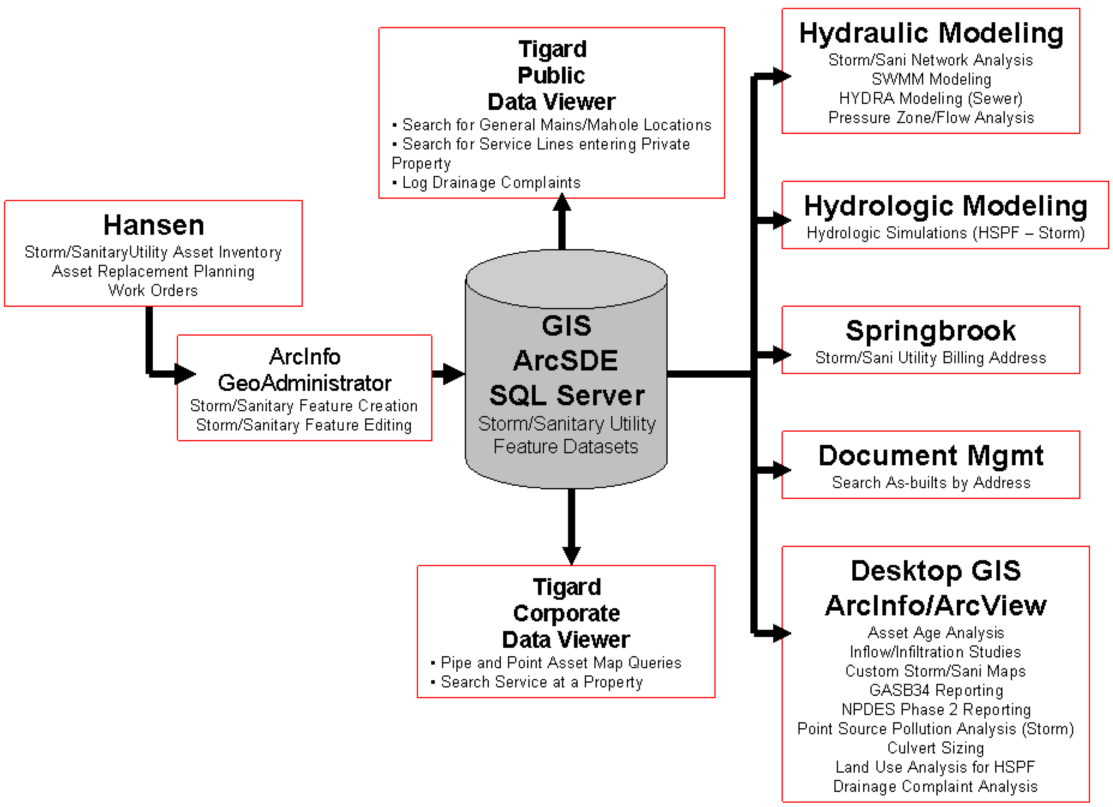
Summary of Goals

- Create a Physical Geodata Model that accommodates the workflow and user requirements for Water Utilities
- Complete a pilot conversion project and test the Geodata model and GeoAdministrator for Hansen/GIS integration

- Identify Water Utility GIS Data Steward
- Complete water system conversion and metadata

Supplement C
Storm/Sanitary Sewer Utility Layer Creation

The City's Public Works department has been managing the GIS Storm and Sanitary (S/S) utility layer using a combination of CAD and GIS. Our recommendation is to centralize the S/S utility data management in the GIS. The S/S network will be converted from non-GIS sources and organized into separate Geodata models consisting of a feature datasets, feature classes, and built-in business logic. The Geodata models will accommodate synchronization with Hansen and will work cooperatively with the GeoAdministrator module. GeoAdministrator will be the primary tool for initiating new and editing existing GIS S/S features. Once converted and managed in the Enterprise GIS, the S/S system networks will be deployed to several external business systems as well as standard desktop GIS applications for custom analysis and mapping (see illustration below).



Geodatabase Design
The process for designing the water utility Geodata model can be replicated for Storm and Sanitary (see Data Assessment Supplement B). Each model should be created in its own workshop with City Staff. Similar to water, the S/S design process should identify the design requirements, including topological relationships of system features, coded domains, and subtypes.

1.) Identify Workflow Requirements

Workflow requirements were identified and documented in this Needs Assessment (see User Requirements document). This analysis included several detailed requirements related to the workflow. For S/S, the most important needs included the ability to provide maps locating system features to City Staff and developers, manage system components for maintenance/replacement scheduling, and be able to create and track work orders.

2.) Develop Conceptual Models and Logical Models
This should be a collaborative process of identifying Network Relationships, Attribute Fields, Subtypes, and Domains (the Logical Model) by sketching conceptual models on flip charts. This should be done in workshops with key participants from the City's Public Works Department.

The Logical GDB models must identify the individual system features, network geometries, attribute fields, and topologies that are the foundation for meeting the workflow requirements. For storm, this will include creating a conceptual model by diagramming how conveyance features interconnect.

For Storm, the City must address these important physical network and functional features:

- Pipes and culverts must be coded with diameter, length, material, condition, end-point invert elevations, and flow direction (important for maintenance/management, GASB34 reporting, and SWMM modeling).
- Catch basins must be coded with type, lid type, material, and condition.
- Pipes (polylines) must be terminated by a point (catch basin, inlet, or outlet). Feature snapping is crucial.
- Outfalls must be uniquely coded to meet NPDES Phase 2 reporting requirements.
- Ditching and natural drainages can be optionally integrated into the model to achieve a superior drainage network.
- Because storm is a gravity network, enforcing flow direction in a geometric network with junctions and edges is particularly useful.

For Sanitary, the City should address the following elements:

- Pipes must be coded with diameter, length, material, condition, end-point invert elevations, and flow direction (important for maintenance/management, GASB34 reporting, and sewer hydraulic models).
- Simplify the ESRI sanitary model by distilling complex edges into two feature classes (mains and laterals), and subtype mains for gravity or pressurized.
- Further simplify the ESRI sanitary model by breaking the SSNetworkStructure feature class into multiple feature classes. The subtypes will be more easily managed as feature classes, notably lift stations.
- Links back to source documents will be required.

For each S/S feature class, required attribute fields, preferred subtypes, and domain lists should be created. In addition to the attributes related to physical properties (type, size, and materials), it was noted that year built and manufacturer information would help scheduling maintenance and replacement projects.

3.) Identify Supporting Hansen Tables/Fields
Leveraging Hansen to manage the water system data and create work orders should be a focus of the S/S GDB designs. Opportunities to move Hansen data to the GIS layers should be identified. Next, the instructions for creating a link between Hansen and GIS should be identified. This includes the addition of GIS fields (primarily "CompKey" and "CompType") required for use of GeoAdministrator.

The S/S network structures should be formulated to establish a one-to-one relationship between feature records in GIS and component records in Hansen. Next, cross-walk tables should be created to show which Hansen fields will specifically link to and populate the GIS attribute fields. This table will be the foundation for creating data reconciliation processes.

4.) Create the GDB Physical Model
The S/S GDB physical schemas should be created in a File Geodatabase within Feature Datasets. ArcCatalog commands can be used for creating feature classes, attribute fields, subtypes, and domains. Topologies should defined using the "Create Topology" tool. The resulting GDB's should be exported to Visio to create diagram posters (one for each). The large format diagrams are the best media for viewing the entire feature dataset schemas and feature class details, and should be used for peer review and quality assurance checking.

Storm/Sanitary Utility Data Fields

It is important to note that not all attribute fields identified in the GIS are directly populated by an equivalent Hansen field. The business requirements for the GIS layers demand the addition of non-Hansen fields. They will be populated and managed by the Storm and Sanitary Utility Data Stewards respectively. It is important that tables are created depicting which GIS fields are populated by Hansen and which are not.

Project Work Plan

The proposed work plan is broken into three phases:
Phase 1 (short term: 3-6 months)

1. Build S/S utility Geodata models (Arc 9.2 and SDE) (see process outlined above)
2. Develop Pilot Project Guidelines (one pilot project for each utility)
    a. Identify Source Data (as-built CAD data, hard-copy as-built records)
    b. Develop Spatial Catalog of Non-GIS Data (quarter section identification of CAD and hard-copy drawings)
    c. Outline Pilot Study Areas (should represent a variety of source data types and may consider using the same pilot area for both storm and sewer)

Phase 2 (mid-term: 6-12 months)

1. Engage support from department heads and key staff
2. Execute Pilot Projects
3. Test GeoAdministrator using Pilot Areas (troubleshoot connectivity and implement modifications to physical GDB designs accordingly)

Phase 3 (long term: >12 months)

1. Complete and document GeoAdministrator application
2. Complete S/S utility conversion processes and associated metadata
3. Formalize data stewardship role for Storm and Sanitary Utilities

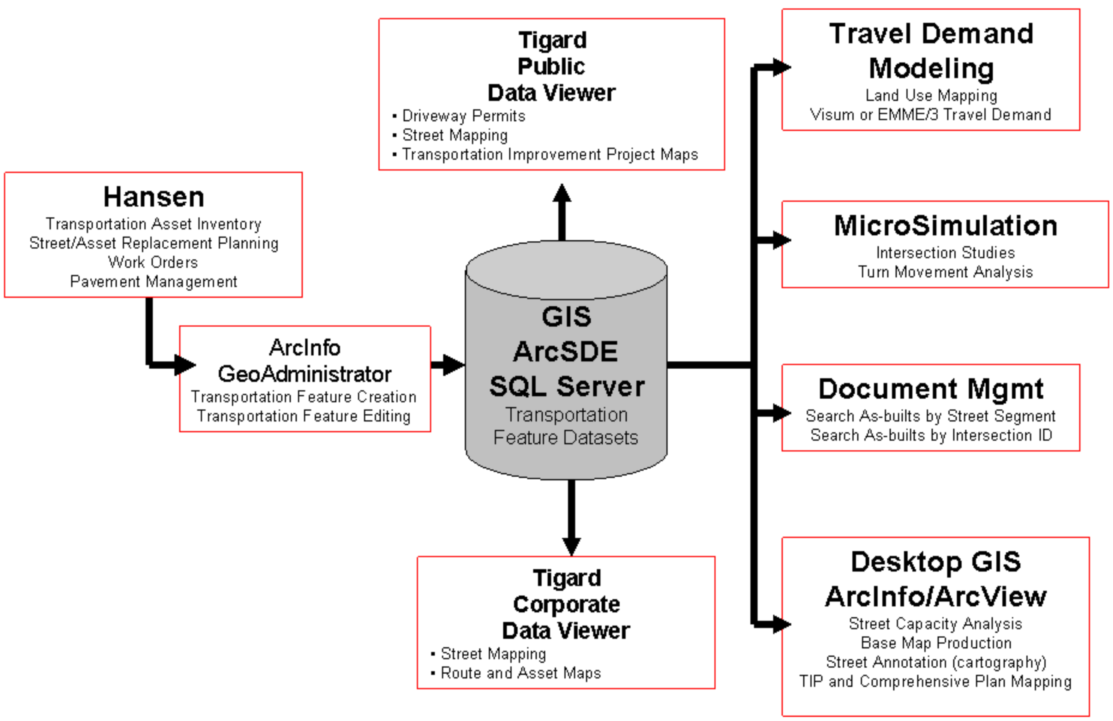
Summary of Goals

- Create Physical Geodata Models (one each for Storm and Sanitary) that accommodates the workflow and user requirements for the two utilities
- Complete a pilot conversion projects and test the Geodata models and GeoAdministrator for Hansen/GIS integration
- Identify Storm and Sanitary Utility GIS Data Stewards
- Complete Storm and Sanitary conversions and metadata

Supplement D
Transportation Layer Creation

The City has been using two street centerline layers. One is from Portland Metro. It is the regional layer used by agencies in the Portland metropolitan area and is used for geocoding and several other applications. The second is a citywide roads layer loosely maintained by Community Development. It contains Hansen ID numbers and serves several planning, engineering, and public works functions of the City.

The Needs Assessment recommends continuing use of Portland Metro's centerline layer for use in linear interpolation geocoding. Furthermore, the City should continue informing Metro of new addresses developed at the City. For the City's street layer, it is recommended that a multi-purpose Geodata model is created that interoperates with Hansen and uses linear referencing to manage physical and operational transportation information. In addition it should operate with the Hansen pavement management module or other pavement systems selected by the City. The following diagram shows the conceptual architecture framework.



Geodatabase Design

The process for designing the transportation Geodata model is similar to the utility models (see Data Assessment Supplements B and C). The model should be created in a workshop with City Staff. Similar to the utilities, the transportation design process should identify the design requirements, including topological relationships of system features, coded domains, and subtypes.

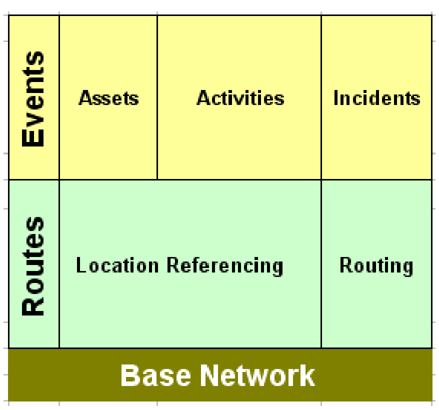
1.) Identify Workflow Requirements
Workflow requirements were identified and documented in this Needs Assessment (see User Requirements document). This analysis included several detailed requirements related to the workflow. For transportation, the most important needs included the ability to provide base maps for a data viewer and custom maps that depict streets and street names, be able to map streets and street-related assets, perform pavement planning, age transportation assets, and create work orders.

2.) Develop Conceptual Models and Logical Models
This should be a collaborative process of identifying Transportation Network Relationships, Attribute Fields, Subtypes, and Domains (the Logical Model) by sketching conceptual models on flip charts. This should be done in workshops with key participants from the City's Public Works, Engineering, and Community Development Departments.

The Logical GDB models must identify the individual system features, network geometries, attribute fields, and topologies that are the foundation for meeting the workflow requirements. For transportation, this will include creating a conceptual model by diagramming how streets, intersections, events, and road-based assets interconnect.

The City must address these important transportation physical network and functional features:

A. The streets feature class in the transportation model should be roughly based on the UNETRANS template and should include three levels. Below is a functional matrix of the three levels followed by a description of each.



a. Base Network
The street segmentation in the base network will very similar to the way it is currently done. The base network should be created as a Geodatabase

Geometric Network. To conform with Hansen, each street, or "edge," must represent a single street block (intersection to intersection or terminus). It must be terminated on each end by a node, or "junction," (snapped to the end of the polyline) that represents an intersection or dead-end. Edges should not contain pseudo nodes. Each edge and junction must contain a unique ID that matches with Hansen (UNITID).

b. Routes
Routes are the foundation for mapping events using Linear Referencing. In Linear Referencing, multiple segments in the base network are dynamically linked and assigned a linear measurement system. It is recommended that routes follow unique street names for more intuitive referencing. Furthermore, there must be a route for each direction of a street.

c. Events
Events are the assets, activities, incidents, and mobile objects that are placed on measured routes. Events should be the method for linking to pavement management and are optimal for mapping lane patterns, medians, sidewalks, and curb-and-gutter. The figure below depicts how event data of variable length may be striped along a route.

```
Greenburg Rd.                                                              Hall Blvd.
| ◄----------------------------------- SW Pacific Hwy ---------------------------------►|
| ◄--------4' Sidewalk----------► ◄-------------------8'Sidewalk-------------------►|
| ◄---------2 Lane Asphalt Westbound-------► ◄--4 Lane Concrete Westbound--►|
●──────────────────────────────────────────────────────────────────────────●
| ◄---------2 Lane Asphalt Eastbound-------► ◄--4 Lane Concrete Eastbound----►|
| ◄--------4' Sidewalk----------► ◄-------------------8'Sidewalk-------------------►|
```

B. Street edges can be subtyped by functional class (local, collector, arterial, highway, freeway) and associated with a legend file for easy mapping.

C. Feature classes other than the road centerlines and intersections will likely include point feature classes identifying assets, such as signs, pedestrian poles, traffic lights, junction boxes, traffic loops, and luminaries. For each transportation feature class, required attribute fields, preferred subtypes, and domain lists should be created. In addition to the attributes related to street physical properties, it was noted that pavement condition would directly benefit pavement management and planning.

2. Identify Supporting Hansen Tables/Fields
Leveraging Hansen to manage the street and related asset data and create work orders should be a focus of the transportation GDB designs. Opportunities to move Hansen data to the GIS layers should be identified. Next, the instructions for creating a link between Hansen and GIS should be identified. This includes the addition of GIS fields (primarily

"UnitID" and "UnitID2," as well as "CompKey" and "CompType") required for use of GeoAdministrator.

The transportation base network structures should be formulated to establish a one-to-one relationship between feature records in GIS and component records in Hansen. Next, cross-walk tables should be created to show which Hansen fields will specifically link to and populate the GIS attribute fields. This table will be the foundation for creating data reconciliation processes.

3. Create the GDB Physical Model
The transportation GDB physical schemas should be created in a File Geodatabase within Feature Datasets. ArcCatalog commands can be used for creating feature classes, attribute fields, subtypes, and domains. Topologies should defined using the "Create Topology" tool. The resulting GDB's should be exported to Visio to create a diagram poster. The large format diagrams are the best media for viewing the entire feature dataset schemas and feature class details, and should be used for peer review and quality assurance checking.

Hansen Interoperability

It is important to note that the point assets in the Hansen street module will not map as events on the routes. Rather, they are associated with segments or intersections, or assigned coordinate locations. It is expected that feature datasets designed in the transportation workshop will include point layers for street signs, transit stops, light poles, pedestrian poles, etc. Other organizations have enabled the storage of linear referencing in Hansen by adding custom tables and fields. This is not recommended for Tigard as Hansen administration will become more cumbersome.

Transportation Data Fields

It is important to note that not all attribute fields identified in the GIS are directly populated by an equivalent Hansen field. The business requirements for the transportation layers demand the addition of non-Hansen fields. They will be populated and managed by the Transportation Data Steward. It is important that tables are created depicting which GIS fields are populated by Hansen and which are not.

Project Work Plan

The proposed work plan is broken into three phases:
Phase 1 (short term: 3-6 months)

1. Build transportation Geodata model (Arc 9.2 and SDE) (see process outlined above)
2. Develop Pilot Project Guidelines
    a. Identify Source Data (existing GIS centerlines, as-built CAD data, hard-copy as-built records)
    b. Develop Spatial Catalog of Non-GIS Data (quarter section identification of CAD and hard-copy drawings)
    c. Outline Pilot Study Area (should represent a variety of source data types and may consider using the same pilot area for the utilities)

Phase 2 (mid-term: 6-12 months)

1. Engage support from department heads and key staff
2. Execute Pilot Project
3. Test GeoAdministrator using Pilot Areas (troubleshoot connectivity and implement modifications to physical GDB designs accordingly)

Phase 3 (long term: >12 months)

1. Complete and document GeoAdministrator application
2. Complete transportation conversion processes and associated metadata
3. Formalize data stewardship role for the transportation layers

Summary of Goals

- Create Physical Geodata Model that accommodates the workflow and user requirements
- Complete a pilot conversion projects and test the Geodata model and GeoAdministrator for Hansen/GIS integration
- Identify a Transportation GIS Data Steward
- Complete transportation conversions and metadata

Pilot Conversion Project Guidelines
Water Utility

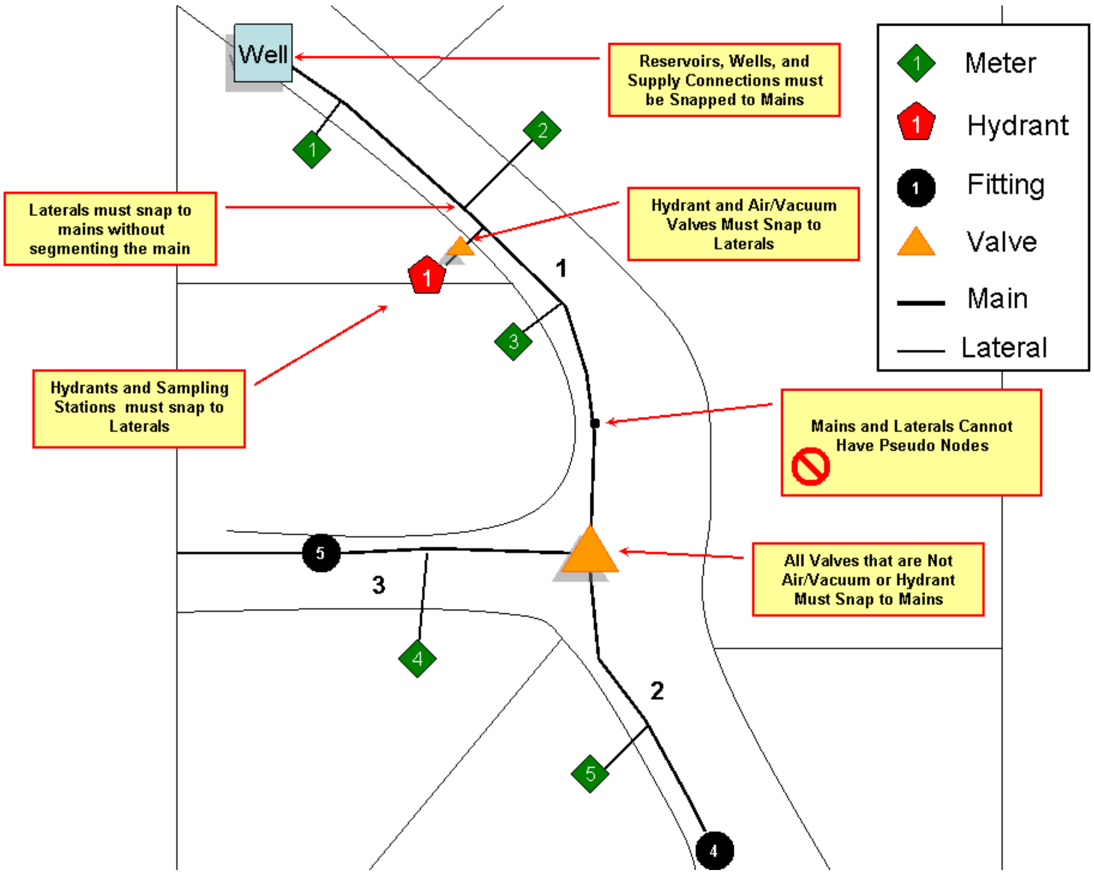
The pilot is a stress test on the Water Utility Geodata model developed as a part of this project, as well as a training exercise for a complete data conversion of the water system. It may also lead to further modifications to the business process for converting and later managing the water utility data.

Supplement B of the Data Assessment recommends the execution of the pilot project in six to twelve months following the completion of these guidelines and the organization of staff to complete the conversion. Results and findings from the conversion must be documented in detail to guide complete system conversion, whether done internally or using consulting support.

Overview of Guidelines
The process for mapping of the water system must be refined in the pilot project. The pilot project should proceed with the following steps:

1.) Research and Document Data Sources
2.) Geographically Reference Drawings and As-builts into TRS
3.) Identify Pilot Study Area
4.) Develop Pilot Data Conversion Methods and Standards
5.) Build a System for Problem Identification and Resolutions
6.) Digitize Data into the GDB Water Feature Dataset
7.) Test Hansen GeoAdministrator for Adding/Editing Features
8.) Develop Quality Control (QC) Check Plots
9.) Peer Review with Field Staff
10.) Identify Efficiency Tools
11.) Develop a "Cookbook" for Final Conversion

Water Network Geodatabase Constructs
The topologies enforced in the water feature dataset involve several business rules. These topologies are important for network integrity and Hansen integration. During the pilot, close attention to the creation and snapping of features will reduce the amount of cleanup for network conformity.



Pilot Conversion Methods

Identify Pilot Study Area

The pilot study area should be a quarter section including a mix of both mains and laterals. Ideally the area would include a storage tank or reservoir and pump station.

Problem Tracking

Problems encountered during the pilot project, both in the conversion process as well as the output geometries, must be logged in problem tracking system. This can be a simple database or spreadsheet. As the pilot conversion proceeds, each incident should be entered into the system. If resolution is found, the solution must be entered in the incident record. Unresolved issues must be reviewed by the project Team at several points during the pilot project.

Anchor Features

Use the 1995 water valve GPS points as an anchor data set. It is assumed these are most accurate. Subsurface features converted from CAD or hardcopy documents must be snapped to the points located using GPS.

Use of Registered Data

Where available, use of registered as-built drawings should preside over manual conversion methods. Line and point data from CAD can be copied into the GIS layers.

Test Hardcopy Conversion Methods
Several documents are only available in hard copy. It must be determined whether the best way of creating vectors from these documents is to scan and register the documents, or simply "heads-up" digitize them.

Once documents are scanned and registered, they can be used as a visual backdrop for tracing point and line features. Alternatively, on-screen digitizing uses best available base map layers as a backdrop for drawing features. Base maps would include aerial photos, parcels, and the valve locations in GIS.

The "heads-up" method will be a cheaper and faster solution. However, several case studies recommend scanning paper documents and registering their section corners or other map features of known coordinates. Testing will determine whether scanning and registering maps are worth the effort. A scanned and registered document should be opened in the GIS. Points should be placed on the valves as depicted on the image. These valve points should then be overlaid with the GPS valve points to determine offset. Offsets of two or more feet would suggest the registered image contains inherent inaccuracies. At this point, heads-up processing may be a better choice.

Meter Locations and Laterals
The water meter readers should help map meter locations in the pilot area. *It is highly recommended that knowledgeable staff use GPS to locate meters in the field*. Laterals should drawn "heads-up," snapping to the main line on the from-end and to the meter point on the to-end.

Attribution of Features
There are several attributes that must be populated once features are created. Where the Hansen "UNITID" is not already populated, it must be hand entered. For applicable features and attribute fields, Hansen data can be joined to the GIS attribute tables. Attributes missing from Hansen must be manually entered from as-built drawings.

Hansen GeoAdministrator Test
Acquire an evaluation copy of GeoAdministrator. Test connectivity to Hansen by a.) adding new features, b.) editing existing features, and c.) joining Hansen data to GIS using GeoAdministrator.

Quality Control Processing
Quality control processing must include printing check plots. Water features should be clearly symbolized. Dirty topologies must be marked. System completeness is the most important issue. Field staff who knows the system must assess errors in the digitized points and lines.

Efficiency Tools
During the pilot, opportunities for automating routine conversion tasks must be identified. These would likely be ArcObject-VBA scripts that ensure feature snapping,

automate creation of point features at the end of lines, and use forms with pull-down lists to add attributes for a feature.

The "Cookbook"

Develop a "cookbook" for final conversion based on the process and procedures developed for the pilot, changes made during the pilot, and changes to be implemented prior to the start of the full data conversion project.

Test Elements

Stress testing must evaluate the process of converting features and attributes as well as the strength and integrity of the resulting geometric network. The final evaluation is the ability to connect to and share attributes with Hansen as well as the performance of GeoAdministrator. Accuracy requirements should be 95% to 98% for both completeness and accuracy. The testing should include an evaluation of snapping distances with the development of an optimal tolerance.

1.) Snap Test – turn on topology dirty areas. Snapping tolerance may require
2.) Pipe end test – material and diameter
3.) Develop attribute data queries to test logical feature relationships (8" water main must match to an 8" valve)

Summary of Goals

- ✓ Identify a Pilot Study Area
- ✓ Identify Final Conversion Methodology
- ✓ Refine Methodology using Problem Tracking System and Quality Control Processes
- ✓ Identify Tools to Enhance Productivity
- ✓ Develop the Cookbook for Complete System Conversion
- ✓ Complete the Water Conversion Pilot by September 2008

Tigard Oregon Water Services Geodatabase Model

September 20th, 2007 Geodatabase Version 2.0